REMARKS

Favorable reconsideration of this application is respectfully requested in view of the following remarks.

Entry of this Amendment is respectfully requested. By way of this Amendment, Claim 19 is canceled. Thus, entry of this Amendment will simplify the issues on appeal because the issues raised in the Official Action concerning Claim 19 will not longer be relevant. Accordingly, it is believed that entry of this Amendment is appropriate.

The most recent Official Action states that the previously submitted specification sheets for LEDs should be submitted by way of a Declaration Under 37 C.F.R. § 1.132. The Official Action does not explain why the LED specification sheets should be submitted by way of such a Declaration. Nor is it understood what purpose would be served by such a submission. Nevertheless, noting the Examiner's comment in the Official Action on this point, the undersigned telephoned Examiner Ralis on November 15, 2008 to discuss the comment in the Official Action and ascertain whether the Examiner might differently view the LED specification sheets and might be persuaded to withdraw the current rejection if the LED specification sheets were submitted by way of a Declaration Under 37 C.F.R. § 1.132. Examiner Ralis' response was rather clear -- the current rejections would be maintained even if the LED specification sheets were submitted by way of a Declaration Under 37 C.F.R. § 1.132.

Applicant explained in the previous response that Baldridge describes heating the disclosed laminate to a temperature significantly exceeding the maximum operating temperature ratings of LEDs as noted on the previously submitted

specification sheets. Responding to this argument, the Official Action points out that the LED specification sheets list a Reflow Soldering Temperature of 260°C for 5 seconds. Because the specification sheets mention a this Reflow Soldering Temperature of 260°C for 5 seconds, the Official Action apparently believes one of ordinary skill in the art would understand that an LED is well able to withstand the conditions encountered during manufacture of a laminated glazing panel. This observation in the Official Action is rather surprising as it is expected that the Examiner would be familiar with differences between the conditions that exist when reflow soldering an LED and the conditions encountered during manufacture of a laminated glazing panel.

By way of example, pages five and six of the Kingbright specification sheets illustrate the mounting or soldering of the LED leads. It is apparent from these illustrations, and known in the art, that the LED itself is spaced from the region of solder. It is thus not surprising that the solder reflow temperature rating of the LED is the 260°C temperature noted in the specification sheets. However, that the LEDs are able to withstand reflow soldering at 260°C for 5 seconds when the LED is spaced from the solder region hardly means the LED can withstand the conditions encountered during manufacture of a glazing panel. Though it is expected that the Examiner may be familiar with conditions encountered during typical glazing panel manufacturing, attached is a short paper discussing the manufacture of laminated glazing panels. The paper makes clear that the glazing is subjected to quite high temperature and pressure conditions (such as those recited in claims at issue here) for an extended period of time -- certainly many times longer than the 5 second interval that occurs during reflow soldering. Thus, there is no correlation between

the 260°C Reflow Soldering Temperature that occurs for 5 seconds during reflow soldering and the high temperature and pressure conditions under which the LED would be subjected for an extended period of time during manufacture of the glazing.

For these reasons, as well as those previously presented, it is respectfully submitted that the claims in this application are allowable.

Should any questions arise in connection with this application or should the Examiner believe that a telephone conference with the undersigned would be helpful in resolving any remaining issues pertaining to this application the undersigned respectfully requests that he be contacted at the number indicated below.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

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HOW TO MAKE A GOOD LAMINATED SAFETY GLASS FOR WINDSCREENS

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ABSTRACT

This paper gives an overview of the complete manufacturing process from glass cutting and PVB cutting (and stretching) to the final inspection of windscreens before shipment.

Special attention should be paid to the processing conditions and their influence on the quality of laminated glass.

Each different de-airing process (nip roll, rubber ring and rubber bag) is reviewed and a range of recommended process conditions provided for each of them.

The last part of this paper concerns "in factory" testing to ensure that windscreens are of good quality both in terms of mechanical performance as well as ageing performance.

1. INTRODUCTION

The market for automotive laminated glass is growing regularly. Almost every new car in the world is now equipped with laminated safety glass and we see many new factories starting-up in different countries especially in the Asia Pacific area.

The process to manufacture automotive laminated safety glass is relatively complex as it involves glass bending technology as well as laminating technology. Being a major contributor to passenger safety, the laminated windscreen must satisfy a number of strict criteria not only in terms of optics but also in terms of mechanical performance and ageing characteristics.

After listing the main criteria for a windscreen, this paper will give an overview of the different steps involved in the manufacturing process with recommended conditions to achieve optimum characteristics of the windscreens. The aim of this process review is to give the manufacturer the opportunity to produce consistently windscreens of good quality at minimal cost.

The latter part of this paper will concentrate on recommended testing to be conducted within the factory to ensure conformity to standards.

2. PROCESS DESCRIPTION

The process flow diagram is divided in 4 main areas:

- glass preparation
- PVB preparation
- laminating process
- final inspection and testing

As one can see the real lamination occurs only in the 3rd step, but a lot of factors in sections 1 and 2 will play a role on the quality of the final product, reason why we really need to start from the basic raw materials glass and PVB.

Glass preparation:	glass storage glass cutting glass washing glass bending glass washing
PVB preparation:	PVB storage stretching - cutting relaxation
Laminating process:	assembly glass + PVB de-airing autoclaving
Final inspection and tests:	edge trimming visual inspection testing packing and storage

3. QUALITY CRITERIA

Following criteria are considered:

- visual appearance: edge bubbles/defects
- optical distortion, light transmission
- mechanical performance: impact resistance (adhesion PVB - glass)
- ageing: stability of laminate with exposure to temperature and radiation.

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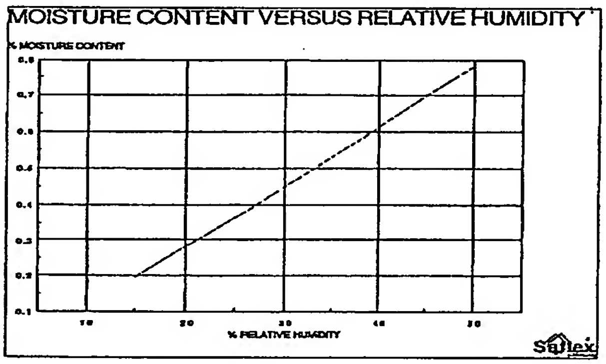
4. PVB CHARACTERISTICS

PVB characteristics influencing W/S quality

4.1. Moisture content:

PVB is hygroscopic and there is a relationship between the relative humidity in the ambient air and the moisture content at equilibrium in the PVB (see graph 1). It is recommended to operate between 0.4 and 0.65% moisture in the PVB.

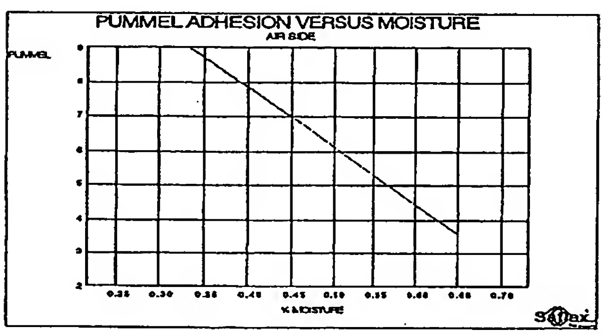
Excessive moisture in the PVB will have a dramatic effect on adhesion but could also induce defects in boil test and eventually milky haze (whitish aspect of the PVB) and delamination.



4.2. Adhesion to glass:

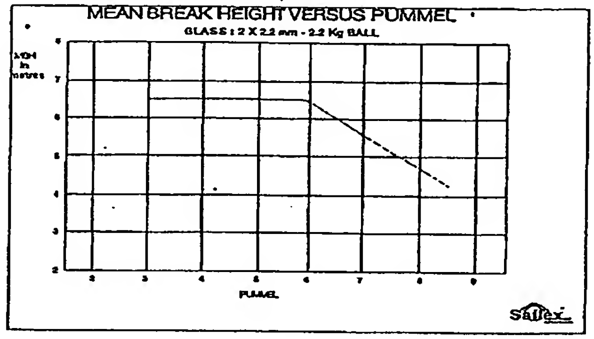
This is the most critical parameter as it controls the mechanical performance (impact resistance of laminated glass). Factors influencing adhesion are:

glass surface and type
glass characteristics
PVB formulation
PVB moisture content (see graph 2).



4.3. Mechanical performance:

Measured by impact resistance in ball drop test. As shown in graph 3, impact resistance is controlled by adhesion of PVB to glass. It is therefore recommended to operate between 3 and 6 Pummel. PVB thickness is also an influencing factor, stretching will obviously reduce thickness and therefore influence mechanical resistance of laminated glass.



5. DETAILS OF PROCESS STEPS

1. Glass preparation

1.1. Glass storage

In order to avoid hydrolysis of the glass surface, it is recommended to keep glass pieces separated by use of a parting agent (Lucite powder for example) and to keep it in dry conditions. It is recommended to mark the tin side of the float glass in order to laminate always with the same glass orientation as it might influence optics and adhesion to PVB.

1.2 Glass cutting

The use of good cutting tool (and lubricant) combined with edge grinding will result in a good edge finish.

1.3. Glass washing

This operation which follows the cutting process will eliminate all contaminants from the glass surface: oil, grease, finger prints, separating agent, dust, etc... The quality of the water used especially for the rinsing process might have an influence on adhesion of PVB to glass as any trace of salt left on the glass after drying will have a negative effect on adhesion especially if there is no other washing step after bending.

We do recommend to use demineralized water for rinsing, water conductivity should be 30 microSiemens/cm max. (ideally 10 microSiemens), water temperature around 40 to 60°C.

Good maintenance of the washing machine is key to have consistent quality.

1.4. Glass bending

In terms of windshield quality, the parallelism of both pieces of glass is critical to avoid glass

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mismatch (bending defects) and bubbles after lamination. PVB will compensate very small variations but cannot fill a hole between both pieces of glass. We generally consider that 0.1 mm is the maximum difference allowable.

1.5. Glass washing

This would be the second and more critical washing step in the process (see 1.3). In some cases, people will not wash after bending and remove the parting agent (based on silica) by vacuum cleaning the glass pieces before assembly. Care should be taken not to leave any contaminant on the glass nor excessive amount of parting agent.

2. PVB preparation

2.1. PVB Storage

As the product is hygroscopic, it is important to ensure that packaging integrity has been maintained (especially the moisture proof bags used to protect the interlayer). Refrigerated interlayer will be kept below 10°C whilst interleaved can be stored at room temperature. There is no need for RH control in the storage area as long as the interlayer is kept within its original packaging.

2.2. PVB stretching - cutting

Stretching is optional but often used with a gradient colour band at the top of the windscreen as this process will allow the laminator to "tailor shape" the curvature of the gradient band to match the curvature of the roof line of the car.

The process has been described at length in another presentation; we will therefore not discuss it any further there.

As far as cutting is concerned, the operation is done at the end of the stretching process when there is one, otherwise, it would be done either manually or automatically (for large OEM operations PVB is unwound and cut automatically in trapezes to reduce waste).

The cut pieces (called blanks) are stacked up to 10-15 cm high representing a full roll 150-175 blanks and allowed to relax before assembly.

Typically we would recommend to unwind and cut the PVB at 18°C (± 5) for 16 hours before usage in a conditioned atmosphere 25 to 30% RH. Special attention should be paid to the cleanliness in this area as any dust particle would be attracted on the PVB surface by static electricity generated during unwinding. The cutting equipment should be grounded and usage of static bars or blowers is recommended.

3. Laminating process

3.1. Assembly

This is the process step where glass and PVB come together. Any contamination, any defect left either on the glass or on the PVB will be laminated and remain present in the final product. It is therefore critical to work in a clean environment. The table below summarises the recommended practice for the assembly room.

Room conditions: – double door entrance (sas) – over pressure in the room – air filtration (dust free) – special adhesive door mats to remove dust from shoe soles – temperature: 18°C – relative humidity: 25-30% – limited passage – special clothing: lint free + gloves and hair caps – floor: tiles or special coating to allow easy cleaning

3.2. Lay-up conditions

Glass surface temperature should be between 25 and 30°C to allow easy positioning of PVB. If the temperature is higher there is a risk of PVB shrinkage, snap back or short vinyl in de-airing process and/or PVB undulation creating problems in the de-airing step. If the temperature is too low the glass pieces might slip during transport to the de-airing process and create glass mismatch.

PVB temperature should be 18°C; it should be laying flat with around 1 cm excess all around, trimming will reduce this to 1-2 mm from the edge without pulling the PVB.

3.3. De-airing

This is probably the most critical part of the whole process. The objectives of this steps are:

1. remove the maximum quantity of air trapped between PVB and glass
2. create preliminary adhesive bond glass/PVB before autoclave
3. edge seal to avoid air penetration during autoclaving.

The potential problems or defects resulting from a poor de-airing are:

– bubbles
– delamination
– poor thermal stability

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There are three main types of de-airing processes:
– nip roll de-airing
– vacuum roll de-airing by rubber rings
by rubber bags

3.3.1. nip roll process:

This process generally uses 2 ovens and 2 sets of nip rollers. Key parameters to control are:
– pressure applied on the rollers
– temperature (glass and PVB)
– line speed

Temperature at exit of first oven should be between 40 and 60°C; the visual aspect of the windscreen should be uniform slightly greyish without traces of air pocket whilst the edges are still open (not transparent).

Conditions at the exit of the second oven will be different:
– glass temperature between 65 and 115°C
– visual aspect exiting the nip rollers should be clearer with a good overall edge seal and no traces of air pockets.

One should be careful with the use of clips after de-airing as those tend to create stresses locally on the windscreen which might result in thinning the PVB and lead to delamination later on.

Windscreens with black serigraphy along the periphery will require slightly different temperature conditions to ensure good edge seal.

3.3.2. vacuum de-airing:

Rather than forcing the air out of the laminate by applying pressure mechanically, the vacuum de-airing process will remove the entrapped air by applying vacuum in and around the windscreens. The process takes longer but generally results in a better de-airing quality, there are 2 different processes: rings and bags.

The key factors in the process are temperature and vacuum. It is indeed extremely important to remove the air whilst the laminate is still cold and later increase the temperature to seal the edges and ensure preliminary adhesion. As the air is being removed from the periphery, any premature edge seal will block the remaining air in the laminate and result in large air pockets and eventually bubbles.

The recommended temperature range for the first step of the process is 20 to 30°C with a minimum vacuum time of 5 minutes before heating.

The vacuum level should be from 0.6 to 0.8 bar and maintained during the whole process.

The temperature of the bags and the rubber rings is obviously critical as this will influence the risk of premature edge seal.

a) Rubber ring process

This is a manual operation by which an operator will install a rubber ring around the windscreen and then connect it to a main vacuum line. The windscreen will then progressively be heated as it moves into an air circulation oven, the maximum glass temperature is around 90°C. When the glass exits the oven the vacuum is disconnected and the rubber ring removed. The windscreen is almost transparent.

Advantages:
– not expensive
– accommodates all windscreen shapes
– excellent de-airing

Disadvantages:
– speed (slow process)
– requires different sizes of rubber rings depending on W/S types
– labour intensive.

b) Vacuum bag process

This is a fully automated process in which the windscreen is automatically loaded into the bag which then closed and is connected to a vacuum pump. The bags move into an air circulating oven where it will reach a temperature of 110-120°C (W/S temp. 100°C). At the end of the oven, the bag will be disconnected from the vacuum line, opened automatically and the windscreen is taken out of the bag by a robot.

This system is used for extensive OEM production series.

Advantages:
– large series
– speed

Disadvantages:
– cost (mainly maintenance cost).

3.4. Autoclaving

During the autoclave process, the remaining air existing in the sandwich will be dissolved in the interlayer and, at the same time, the interlayer will flow within all glass surface micro cracks and fill the gap between the pieces of glass.

After this step, the laminated glass is completely transparent and offers its final performance characteristics.

The recommended operating conditions are listed below:
– load the autoclave shortly after de-airing (less than 12 hours)
– pressure and temperature should increase simultaneously
– recommended temperature: 130-150°C

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– recommended pressure: 12-15 bar

– hold time at maximum pressure and temperature: minimum 20 minutes (will depend on autoclave type and air circulation flow within the autoclave).

It is very important to maintain the pressure during the cooling step until the glass temperature has reached 50°C maximum. Failing to do so would create a series of small bubbles around the edge of the laminated windscreen.

4. Final Inspection and testing

4.1. Edge trimming and visual aspect

Those operations are done simultaneously after autoclaving. Each windscreen passes thru an inspection station in which an intensive light beam is projected thru the windscreen. Inspectors will check the overall appearance as well as any objectionable defect: contamination, glass scratches, edge bubbles etc... Those windscreens will be either rejected or sent for repair or re-autoclaving. All others will be treated for edge trimming, - operation by which one trims the excess PVB around the edge of the laminate - and then packed in crates for shipping.

4.2. Testing

As discussed in the section 3 "Quality Criteria", one needs to ensure that windscreens satisfy visual, mechanical performance and ageing criteria. Those tests are done in the Quality Control Laboratory by selecting randomly a few windscreens out of the daily production.

We would recommend to do the following tests:

– visual inspection - optical distortion
– adhesion testing
– impact testing
– boil and bake tests.

4.2.1. Optical testing:

Aside from the visual inspection done in production, windscreens should be tested for optical distortion according to national or international standards, to ensure that there would be no distortion of the view of the driver or its passenger. A slide projector is used to project a special image thru the windscreen on a grid board. Any optical distortion would appear as a deformation of the image on the grid board. Main causes for optical distortions are glass bending defects or glass particles left in the laminates which will cause a lens effect.

4.2.2. Adhesion testing:

The most widely used adhesion test done so far is the Pummel test by which a piece of glass cut from a windscreen has been conditioned for a minimum of 2 hours at -20°C and then pummelled with a hammer. The amount of glass particles still adhering to the interlayer is then compared to a set of standards, the recommended range is from 3 to 6 Pummel to ensure good windscreen performances.

4.2.3. Impact:

This test is specified in the standards. One drops a steel ball of 2.26 kg from a height of 4m on samples 30x30 cm square cut from windscreens. The glass might break but the ball should not pass thru during impact. As indicated above when the adhesion level is within 3 to 6 Pummel, one should pass the test without any problem.

4.2.4. Boil test:

This is also specified in the standards. A piece of laminated glass cut from the windscreen is being put for 2 hours in boiling water. After this test, a whitening of the interlayer is allowed around the edge but no bubbles nor any other defects are allowed in the laminate.

4.2.5. Bake test:

Although not official, we often test windscreen stability by use of a bake test during which we would submit windscreen samples to heat in an oven (16 hours at 100°C, followed by one hour each time 10 degrees higher until first bubbles appear). This test is a good prediction of the de-airing quality and stability in hot climates. The minimum temperature for bubble appearance should be 130°C.

CONCLUSIONS

We have reviewed here the main steps of the manufacturing process for automotive laminated glass. If one follows our recommendations and pays attention to the critical steps and advises given in this paper, one could reasonably expect to make excellent quality products contributing to the overall safety of the passengers of automotive vehicles.

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